



BTO Research Report No. 194

**Scrub Management for Conservation
in Lowland England:
Practices, Problems and Possibilities**

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1. SUMMARY

1. Scrub creates particular problems in managing habitats for conservation. At many sites it is seen as an invasive threat to existing open habitats of high conservation value, yet scrub mosaics can support rich communities of animals, especially insects and birds. This report assesses the extent to which scrub is actively managed as a habitat in its own right ('active management'), outlines the management practices that are most commonly adopted, discusses the problems of achieving sustainable scrub management and makes recommendations about work that is needed to better understand the conservation value of scrub.
2. Eleven nature reserves were visited to help gain an appreciation of current scrub management practices. Additional information was provided by the National Trust concerning scrub management for conservation on their properties.
3. It is concluded that there is considerable interest in managing scrub habitats for conservation and on eight of the 11 sites visited large-scale maintenance of scrub habitats is a major element of the management objectives. Active scrub management for conservation reasons is also undertaken on many National Trust properties. Much of this management appears to be aimed at creating and maintaining a variety of scrub growth stages; insects and birds are the most frequently cited 'target groups'.
4. Active scrub management is predominantly undertaken by rotational cutting. The principal exception is Gorse management for which burning as well as cutting is used. We are only aware of grazing being used to maintain grass-scrub mosaics on a handful of sites. Grazing is, however, widely used to prevent scrub growth in open habitats.
5. A fundamental problem in seeking to conduct sustainable scrub management is that the characteristic mosaic structures that form when scrub invades grassland are extremely difficult to maintain or re-create. Rotational cutting is likely to turn the vegetation into relatively uniform coppice-like structures that lack the fine-scale mosaics of grass and scrub. Grazing may offer more possibilities for maintaining such mosaics but there is little available information on appropriate practices.
6. A new classification of scrub types is needed: the National Vegetation Classification does not describe the range of variation in British scrub adequately.
7. It is suggested that a comprehensive review be undertaken to identify more exactly the conservation value of different types and structures of scrub and the circumstances under which scrub should be tolerated or encouraged to expand. The findings of such a review could feed into the development of local and national policies for scrub conservation.
8. There is a need to learn more about successional changes in animal communities that occur as scrub invades grassland and to compare these changes with those that occur under rotational cutting. For birds this work should examine both breeding and wintering bird communities, including requirements for roosting. Experimental work on scrub management and responses of insects and birds is highly desirable. In particular it is suggested that (a) experimental grazing regimes are established on a small number of sites to assess the feasibility of sustaining grass-scrub mosaics, (b) comparisons are undertaken of short and long-rotation cutting to assess whether the former has potential for maintaining mosaics.

2. INTRODUCTION

2.1 The Scrub Debate

Scrub is dynamic vegetation taking many different forms. Usually scrub is regarded as a seral stage between open habitats, such as grassland or heathland, and some form of woodland. Before man had cleared much of Britain's natural woodland, scrub would probably have persisted naturally as a climax community at some exposed coastal sites, at the upper limits of tree growth and possibly in some river valleys where floods prevented establishment of large trees. It would also have been a transitional stage within treefall gaps in woodland.

In the cultural landscapes of the twentieth century, scrub is typically regarded as a symbol of landscape dereliction. Even the attitude of British conservationists towards scrub is one of ambivalence. This is interesting because few would question the conservation value of hedgerows, which are mostly man-made linear belts of scrub. There are several reasons for scrub being widely perceived as a 'poor relation' among British habitats. Being transient vegetation that is neither grassland nor woodland, scrub does not fit easily into systems of classifying habitats. Evidence for this is given by the National Vegetation Classification which only recognises four types of scrub and two of underscrub (Rodwell 1991). Scrub does not sit comfortably with the philosophy that 'traditional management practices' lie at the heart of habitat management on nature reserves. Scrub is frequently seen as a threat to the open habitats and their associated flora and fauna that were sustained by traditional management, this being undeniably the case for heathland, unimproved grassland and fens. Scrub invasion is a particular problem for plant conservation because it can lead to shading, build up of litter and increase in nutrient levels. Many plants of open habitats are unable to tolerate these conditions and succession to closed scrub generally results in reduction in floristic richness (K.A. Hearn in litt.). Scrub invasion is also detrimental to reptiles that require basking areas (Wild & Entwistle 1997) and to ground-dwelling and nesting invertebrates requiring bare ground or short vegetation with a warm microclimate, including many Hymenoptera, ground beetles and spiders (Kirby 1992). Grassland insects will also eventually disappear as scrub encroaches on grassland but these communities are generally replaced by other complex assemblages of invertebrates (see below).

Scrub habitats have always been a part of the British landscape. It is to be expected, therefore, that many organisms are adapted to exploit some form of scrub as their principal habitat. This is the case for a wide range of invertebrates. As structural complexity of vegetation increases so does the overall diversity of insects (Strong *et al.* 1984). However, this general trend of increasing insect species richness conceals the fact that there is much turnover in the insect species composition between different stages of succession. Different communities of invertebrates are associated with different phases of the succession from grazed grassland to closed scrub (V.K. Brown pers comm). Mosaics of grassland, scrub and woodland can also support extremely rich assemblages of breeding birds, often including high densities of breeding warblers and other migrant birds such as Nightingale and Turtle Dove¹ (Fuller 1995). On heathland, Gorse scrub is an important component of Dartford Warbler territories (Bibby 1979). Outside the breeding season, scrub habitats can also offer rich feeding for frugivorous birds and roost sites for Starlings, thrushes, finches and buntings. Long-eared Owls are believed to be heavily dependent on scrub as winter roosts and many birds also breed in scrub (R. Williams pers comm). Whilst the conservation interest of scrub lies mainly with insects and birds it is worth

¹Scientific names of species are listed in the Appendix 3

noting that Hopkins (1996) listed 34 species of rare and local plants associated with scrub vegetation.

2.2 The Case for Sustaining Scrub Through Management

There appears to be a widespread attitude that scrub cannot be valuable in its own right *because* it is relatively easily created and because species that colonise it are likely to be good dispersers and, hence, not particularly vulnerable. This is understandable in the context of open heathland, unimproved grassland and fen habitats which have become so fragmented and reduced in extent.

However, in recent years there has been growing recognition of the conservation value of scrub (e.g. Dolman & Land 1995, Fuller & Peterken 1995, Hopkins 1996). Scrub can support extremely diverse and rich assemblages of animals including some specialist species. Scrub can also be important for epiphytes, particularly bryophytes (K. Hearn pers. comm.). In a wider countryside context it potentially has an important function in enhancing biodiversity. Within reserves too, scrub has conservation value where it is not a threat to long-established valuable open habitats.

Many animal species that utilise scrub do so only for rather short periods of time when structural conditions are suitable for them. The growth and development of scrub vegetation is accompanied by rapid turnover in the composition of associated animal assemblages. For instance, much of the surviving scrub that came into creation following the massive reduction in the rabbit population through myxomatosis in the 1950s, is now too old to be of great value as a habitat to most 'scrub specialists'. There is a need for a better understanding of how scrub management can be undertaken so as to benefit scrub specialists. Where scrub management does not conflict with other interests, especially in grassland and heathland, there would appear to be opportunities for imaginative management to maintain complex scrub mosaics to the benefit of ecotonal animal communities. There are, however, major difficulties in developing sustainable scrub management and these are explored in this report.

In attempting to identify requirements for research on bird assemblages in scrub we became aware that extremely little information was available on current scrub management practices. We therefore decided to document scrub management practices at a range of nature reserves, mostly National Nature Reserves which were known to hold substantial amounts of scrub. The habitats encompassed dunes, heathland and various dry grassland / scrub mosaics including several downland sites in southern England. We did not visit any examples of permanently wet scrub (e.g. Willow scrub colonising gravel workings, Carr scrub, Alder Buckthorn scrub). In all cases the scrub was pioneer woody vegetation colonising formerly open land. Hedgerows, young plantations and coppice were, therefore, excluded from our definition of scrub.

Throughout this account we draw a distinction between two forms of scrub management which can often be found on different parts of the same site. *Restorative* or *control management* involves the removal of scrub to allow restoration of other habitats, such as grassland or heath. On some of the reserves visited in this study, the aim of restorative management was to reduce the scrub cover to a level similar to that which occurred before myxomatosis. *Maintenance* or *active management*, however, is designed to encourage young growth and create a mosaic of ages and structures within scrub whilst preventing development into old scrub or woodland.

Specific aims of this report are to:

- Identify the extent to which scrub is actively managed as a habitat in its own right

(‘active management’) rather than controlled because it is perceived as a problem.

- Document management objectives for scrub where this is being actively managed.
- Assess the frequency with which different management practices are adopted in active management (cutting, burning, herbicides, grazing).
- Discuss alternative approaches to managing scrub to those that are being widely used at present.
- Discuss the problems of achieving sustainable scrub management.
- Identify research and other information needs with respect to scrub management and conservation.

3. SOURCES OF INFORMATION

Accounts of scrub management were produced for 12 sites (Table 1) following site visits and detailed discussions with site managers. Most of these sites were visited between October 1996 and April 1997 by SG who wrote the site accounts (Appendix 1). One of the sites, the New Forest, was different to the others in that it is not a reserve and the scrub management undertaken there is not carried out specifically for conservation purposes. The New Forest is, therefore, excluded from most of the discussion that follows on conservation management of scrub. The management techniques employed on these sites are summarised in Table 2. Other sources of information drawn upon in this report are a site visit by RJF to Lydlinch Common, Dorset, in May 1996. This site consists of a mosaic of grassland, Blackthorn scrub and secondary woodland. Katherine Hearn of the National Trust kindly provided a summary of scrub management being undertaken on National Trust properties (Appendix 2).

Table 1 Details of the sites visited.

Site Name	O.S. Grid Reference	Brief Description
Ainsdale NNR, Lancashire	SD2912	Coastal dunes. Mainly Birch scrub with Balsam Poplar, Sea Buckthorn and Creeping Willow.
Arne RSPB Reserve, Dorset	SY9889	Heathland. Gorse, Birch, Scots Pine and Rhododendron scrub.
Aston Rowant NNR, Oxfordshire	SU 7297	Chalk downland. Diverse, mixed chalk scrub vegetation including Juniper.
Barnham Cross Common LNR, Norfolk	TF8783	Breck grassland. Scots Pine, Oak and Gorse scrub.
Castor Hanglands NNR, Cambridgeshire	TF1101	Grassland. Mixed scrub including much Blackthorn.
Fontmell Down Wildlife Trust Reserve, Dorset	ST8817	Chalk downland. Mixed chalk scrub.
Gibraltar Point NNR, Lincolnshire	TF5658	Coastal dunes. Scrub mainly Sea Buckthorn.
Martin Down NNR, Hampshire	SU0419	Chalk downland. Mixed chalk scrub.
Old Winchester Hill NNR, Hampshire	SU6420	Chalk downland. Mixed chalk scrub including Juniper and Yew woodland.
Saltfleetby-Theddlethorpe Dunes NNR, Lincolnshire	TF4790	Coastal dunes. Mainly Sea Buckthorn scrub.
The Lizard NNR, Cornwall	SW7323	Lowland heath. Scrub mainly consists of Gorse.
New Forest, Hampshire	SU2303	Heath, grassland, bog and woodland. Gorse scrub on heathland with invasive Scots Pine / Birch in areas. Local scrub invasion on lawns.

Table 2 Management techniques (cutting, burning, herbicide, grazing) used within scrub habitats on the sites visited. C = scrub **control** management i.e. the technique is used to remove existing scrub or to prevent its reestablishment on grassland or heathland. M = scrub **maintenance** management i.e. the technique is used to develop a diversity of age classes, new scrub structures or scrub mosaics. In the case of herbicides, the use of stump treatments such as ‘Timbrel’ are not recorded nor is use of herbicides on non-woody vegetation. In the case of grazing, C and M refer to domestic stock (mainly sheep and cattle) but the presence of wild grazers is recorded separately.

	Cut		Burn		Herbicide		Grazing		Principal Wild Grazers (with a significant effect on vegetation)
	C	M	C	M	C	M	C	M	
Ainsdale	*						*		
Arne	*	*	*		*		*		Deer
Aston Rowant	*	*			*		*		Rabbits
Barnham Cross Common	*	*							Rabbits and low densities of deer
Castor Hanglands		*					*	*	Heavy deer grazing
Fontmell Down	*	*					*		Deer and rabbits
Gibraltar Point	*	*					*		Rabbits
Martin Down	*	*			*		*	*	Rabbits
Old Winchester Hill	*	*			*		*		Rabbits
Saltfleetby- Theddlethorpe		*					*		Rabbits
The Lizard	*	*	*	*			*		

4. MANAGEMENT OBJECTIVES AT SITES HOLDING SCRUB

All the reserve managers at the sites visited viewed scrub as a potentially valuable habitat for wildlife although the degree to which it was tolerated varied across sites, dependent on the conservation priorities of each reserve.

All the sites visited were mixtures of scrub and grassland or heathland. At three of the 11 sites (Ainsdale NNR, Barnham Cross Common and The Lizard) the emphasis of the management objectives was on extending the area of open habitat (grassland or heathland) and this entailed considerable scrub or woodland removal. At each of these sites, however, some areas of scrub will be retained and presumably be managed by some form of rotational cutting. Large scale, one-off removal of scrub has also taken place at Gibraltar Point but there was also a commitment to retain substantial areas of scrub at this reserve. At the other eight sites, large-scale scrub maintenance management was an integral and major part of the reserve objectives. The scrub at two of these sites was predominantly Sea Buckthorn, at one site it was Gorse and at five sites it was Hawthorn or mixed scrub. Therefore, at the majority of sites, the scrub was recognised as being of conservation value in its own right and management plans were in place to prevent it developing into woodland and to maintain a diversity of scrub structures. None of the sites, however, was managed solely for its scrub habitats. In all cases there were areas of grassland or heathland on which scrub development was prevented by grazing, by cutting, by burning or by a combination of these practices.

At seven of the eight sites visited where active management was being carried out, the objective was to maintain a diversity of age classes and scrub structures. At the eighth site (Old Winchester Hill) the objective appeared to be more focused on maintaining the present balance of grassland, scrub and woodland. The creation of diverse scrub habitats was generally seen as broadly beneficial to a wide range of species and was an integral part of maintaining the species richness of reserves. Only in three cases did particular species feature as a justification for scrub maintenance management: Dartford Warbler at Arne, Black Hairstreak at Castor Hanglands and Duke of Burgundy Fritillary at Martin Down. At several of the National Trust sites (Appendix 2) management was being conducted for 'key species' including Nightingales (four sites), Dartford Warbler (two sites), Brown Hairstreak (three sites), Dark-green Fritillary (one site), High Brown Fritillary (one site), Dormouse (one site). Invertebrates and birds feature prominently in the reasons for managing scrub both on National Trust properties and elsewhere.

In conclusion, it is evident, even from the limited sample of sites we visited, that active management of scrub is being widely practised on lowland nature reserves, sometimes on a substantial scale. This is substantiated by the large number of National Trust properties where active scrub management is taking place (Appendix 2). It appears that there is considerable appreciation of its conservation value among conservation managers and that on many reserves scrub is managed either alongside, or as an integral part of, grassland and heathland habitats.

5. SCRUB MANAGEMENT TECHNIQUES AS CURRENTLY PRACTISED

This section emphasises the techniques employed in maintenance management of scrub. For detailed discussion of justifications and techniques of scrub control in heathland, grassland and wetland habitats see chapters in Sutherland & Hill (1995).

The principal management techniques applied on each reserve visited are summarised in Table 2. The four main techniques available for managing scrub are cutting, burning, herbicides and grazing. These can sometimes be used in combination but this is not generally the case. Cutting is by far the most frequently used technique, being used for maintenance management on 10 of the 11 reserves visited. Rotational scrub cutting, both as scallops and blocks, is also used on predominantly Blackthorn scrub at Lydlinch Common, Dorset, where it appears to be successful in creating a diversity of age classes which are used by a variety of warblers and Nightingales. Cutting is, of course, also widely used in scrub control. Burning was used on just two reserves (Arne and The Lizard), in both cases for managing Gorse. Burning is also used for managing Gorse on several National Trust properties (Appendix 2). Systematic burning of Gorse is also undertaken in the New Forest but principally with the aim of maintaining forage quality for stock. Spot spraying with herbicides was not used for maintenance management at any site visited but it was occasionally used to control scrub (Birch on heathland and Dogwood on downland). Herbicide stump treatment to prevent regeneration following cutting was, however, common practice on the reserves visited. Interestingly, grazing was used at 10 out of 11 sites to control scrub but it was not generally used to maintain scrub structures. There were two exceptions albeit on a small scale. At Castor Hanglands grazing has been occasionally used within established or developing scrub to create more diverse structure. At Martin Down light intermittent grazing is being used to maintain low scattered scrub in rank grassland. In summary, therefore, rotational cutting is the typical method employed to maintain dry scrub habitats with the exception of Gorse where burning, as well as cutting, is often employed.

Rotation lengths for scrub cutting regimes varied among sites, presumably according to rates of regeneration and factors such as availability of labour. The shortest rotation length was at Aston Rowant where some Hawthorn was cut on a six to seven year cycle. The Gorse at Arne was cut on a 15 year rotation. At both Sea Buckthorn sites the rotation was about 20 years. The longest rotation was 30 years, at Castor Hanglands. The sizes of blocks cut also varied but were generally rather small (e.g. 0.5 acres at Saltfleetby-Theddlethorpe). We gained the impression that the cut blocks were typically somewhat smaller than coppice compartments. On some sites 'scaloping' of block edges, making the boundaries between the scrub and surrounding habitats more gradual, and the removal of developing tree standards to prevent the natural succession to woodland take place. A further method of cutting is found at Castor Hanglands where old Blackthorn is layered by partially sawing through the trunks, laying them on their side and allowing them to regrow.

6. SUSTAINABLE SCRUB MANAGEMENT: IS IT POSSIBLE?

By sustainable scrub management we mean the long-term maintenance of diverse scrub structures in the form of mosaics of grassland and bushes. This effectively requires arresting successional development which is an extremely difficult thing to achieve. It is likely that present scrub management techniques often do not succeed in achieving this. Under some rare circumstances (e.g. on unstable cliffs, see Appendix 2) natural processes may create structural diversity thus removing the need for management.

Rotational cutting is the principal means by which active scrub management is implemented. The site managers often refer to this as 'coppicing' and repeated cutting of scrub will indeed probably lead to a coppice-like structure (Fuller & Peterken 1995). This is not entirely desirable where the aim is to maintain the structural diversity characteristic of the early and middle stages of scrub succession on formerly open land. Such pioneer scrub has a fundamentally different structure to coppice. The former is, in the early stages, often an intimate mixture of grassland patches and colonising bushes - it is essentially a mosaic. Hence the spatial complexity of vegetation in the early and middle stages of secondary scrub succession can be considerably greater than typically occurs in coppice. This will be important to many invertebrates and probably also to some birds. Rotational cutting of scrub theoretically ensures the continuity of a range of successional stages and their associated fauna. However, it is most unlikely that all the microhabitats, fine-scale mosaics and edge structures typical of naturally establishing scrub will persist within rotationally cut scrub. This will be especially true where the scrub is cut on long rotations that allow a dense closed canopy to develop. Hopkins (1996) stressed the need for undertaking scrub management before canopy-closure.

To some extent these problems could be reduced by cutting the scrub before it closes canopy, at least on part of the site. The adoption of 'split rotations', as used within some coppiced woods, may help to maintain mosaics of grass and scrub within the shorter rotation areas, at the same time ensuring that areas of older scrub growth are always present. Heavy grazing would probably be needed within the short-rotation areas following scrub cutting to help retain the grassland. Though rarely used for this purpose, some form of grazing would seem to be a valuable, possibly essential, component of management systems seeking to maintain complex mosaics of grassland and scrub. To our knowledge, the feasibility of sustainable scrub management has yet to be demonstrated and there is clearly immense scope for experimental management.

7. GRAZING AS AN ALTERNATIVE APPROACH TO CUTTING

Fuller & Peterken (1995) have suggested that low intensity grazing may be a more satisfactory way of maintaining scrub mosaics than cutting. As far as we are aware, however, this approach is very rarely used in lowland in the United Kingdom to actively manage scrub for conservation purposes. The only examples of which we are aware are four National Trust properties where stock are used to maintain grass-scrub mosaics and graded scrub edges (Appendix 2) though note the comments about Castor Hanglands and Martin Down above. Goats are being used on the Ventnor Downs, Isle of Wight, and on Darra Island, Strangford Lough, Northern Ireland. Cattle and / or sheep are used at White Park Bay, Co. Antrim and at Hatfield Forest, Essex.

Most of the reserves we visited used stock to control scrub development in open habitats. Superficially, therefore, it would seem that availability of stock is not a basic problem preventing the adoption of this management approach. In practice, however, the type of stock required for grazing grassland or heath may not be suitable for grazing within scrub habitats - there is a need for types of stock that will browse the scrubby growth (e.g. goats, hardy cattle). It may also prove difficult to find graziers willing to operate at sites which provide relatively poor quality forage which will be the case at most scrub sites. Another perceived problem may relate to the timing of grazing. Managers may be unwilling to graze stock in mosaics of grass and scrub in the spring and early summer because this may remove flower heads and cause possible public relations difficulties, yet grazing at this time may be essential to inhibit scrub growth. For further discussion of some of the issues surrounding grazing see van Wieren (1991) and Hearn (1995).

There are considerable opportunities for experimentation in using intermittent or sporadic light grazing in an attempt to arrest scrub at different stages of development and to create fine-scale mosaics of grassland and scrub. A critical component of active scrub management is to avoid allowing the scrub to form a dense closed canopy over large areas. In practice this may be best achieved by using grazing in combination with scrub cutting on a modest scale to achieve the most complex structures. Such flexible management demands considerable skill from site managers and may not be amenable to the development of strict prescriptions

8. INFORMATION AND RESEARCH NEEDS IN RELATION TO SCRUB CONSERVATION

Our discussions with many people during the preparation of this report have confirmed that there is considerable interest in the ecology of lowland scrub and in its active management for conservation. In the uplands there is also a growing interest in the ecological and conservation implications of scrub development that might occur on a large scale if grazing pressure by deer and sheep is reduced (Usher & Thompson 1993, Hester 1995, Fuller 1996, Gillings *et al.* in press, Gillings & Fuller in press). There is, however, a wide range of opinion about the conservation value of different types of scrub and about the circumstances under which it should be removed, tolerated or encouraged. There is a serious lack of information about the extent and changing status of different scrub types. We suggest that information needs fall into three categories: (a) the need for an improved description of scrub types and their status, (b) the need for a review of the conservation value of scrub, (c) the need for research, especially on the effects of scrub vegetation dynamics and scrub management on insect and bird communities. Each of these is discussed below.

8.1 The Need for a Comprehensive Classification of Scrub Types

Current systems of classifying scrub vegetation types are rather unsatisfactory. Hopkins (1996) pointed out that the National Vegetation Classification does not recognise certain types of scrub e.g. Juniper and Box. Furthermore, Ratcliffe (1977) gives a classification of scrub in which 11 types are recognised for calcareous soils alone while Duffey *et al.* (1974) identify seven likely courses of succession from grassland through scrub to woodland for south and east England. For upland Scotland, Hester (1995) has described the major types of scrub that occur. Clearly there is a need for a comprehensive classification of British scrub types. This is an essential precursor for the development of national strategies for scrub conservation.

8.2 Quantifying the ‘Scrub Resource’

There is an absence of information on current amounts and distributions of scrub. An assessment of current status could be linked with the development of a new classification of scrub types (8.1). Ideally an analysis of the recent pattern of change in scrub (over say the last 50 years) is needed and of the socio-economic factors driving the changes.

8.3 A Proposed Review of the Conservation Value of Scrub

There is considerable general uncertainty about the value of scrub compared with other similar habitats such as woodland glades and coppice. There is also more specific uncertainty about the types of scrub (both floristic and structural types) that are of greatest conservation value. We argue that there is a strong case for a comprehensive review being undertaken of the conservation value of scrub and of conservation attitudes and policies, both local and national, towards scrub. Such a review could embrace the following.

- Appraise the pros and cons of different types and structures of scrub for conservation (i.e. the extent to which they support distinctive biological communities and the extent to which individual species depend on scrub habitats).
- Make recommendations about which are the highest priority scrub habitats (types

and structures) for conservation and identify the biodiversity value of the commoner types of scrub in a wider countryside context.

- Consider how scrub conservation policies might be promoted.

8.4 Research Needs on Animal Communities in Relation to Scrub Structure and Management

There is a need to learn much more about the dynamics of animal communities (especially insects and vertebrates) within scrub habitats. Elements of this work are detailed below.

- Successional changes need to be much more fully documented so that turnover in species composition is better understood and individual species can be better placed with respect to their preferred location within successional gradients.
- Comparisons of species distributions across ‘successional gradients’ created by (a) natural scrub invasion of open habitats and by (b) rotational cutting. Detailed comparisons of scrub structure created under these two situations are needed. It would seem that there are sufficient study areas in existence to allow such work to be carried out now. However, experimental work on habitat management is also desirable (see below).
- Work on successional changes should ideally be conducted in different types of scrub to assess the generality of trends in species composition and structure. Particularly for insects one would anticipate large differences in community composition between scrub types but this may also be true for birds. This would also give insights into whether species-poor scrub (e.g. scrub dominated by Hawthorn, Blackthorn or Birch) differed in community patterns to more diverse scrub (e.g. mixed calcareous scrub). For birds it would be desirable to undertake this work in both the breeding season and winter. Scrub is an important roost habitat but rather little is known about the roosting requirements of different species.
- For selected species, a better understanding is desirable of how variation in the patchiness of vegetation structure and microhabitats (e.g. edge structures) affects distribution within scrub habitats. In the case of birds, this would give insights into how species actually use scrub mosaics. Such work is desirable on nesting and feeding requirements of long-distance migrants (Turtle Dove, Garden Warbler, Nightingale).

Experimental work is also needed on the effects of scrub management on animal communities. In particular, the habitat structures created by different cutting and grazing regimes should be compared with those that are evident in natural scrub invasion. It is suggested that key elements for monitoring within treatments are: (a) changes in various components of scrub structure, (b) availability of berries as food for birds, (c) responses of invertebrates, (d) use of the treatments by breeding and wintering birds. Unfortunately, none of the sites that we visited would provide a sufficiently large area of scrub to undertake large-scale replicated experiments on several treatments. Scale is a particular problem for obtaining reasonable sample sizes to analyse responses of birds. We suggest, however, that particular consideration is given to:

- The creation of experimental grazing regimes with hardy stock on a small number of sites to assess the feasibility of sustaining grass-scrub mosaics.

- The comparison of short-rotation cutting (pre-canopy closure) and long-rotation cutting to assess whether the former can be used, possibly in conjunction with intermittent grazing, to sustain grass-scrub mosaics.

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APPENDIX 1

SITE ACCOUNTS

Ainsdale, Lancashire
Arne, Dorset
Aston Rowant, Oxfordshire
Barnham Cross Common, Norfolk
Castor Hanglands, Cambridgeshire
Fontmell Down, Dorset
Gibraltar Point, Lincolnshire
Martin Down, Hampshire
Old Winchester Hill, Hampshire
Saltfleetby-Theddlethorpe Dunes, Lincolnshire
The Lizard, Cornwall
New Forest, Hampshire

AINSDALE NATIONAL NATURE RESERVE, Lancashire (SD 2912)
(Visited 10/4/97)

Introduction

Ainsdale NNR covers 492 ha on the Sefton Coast between Formby and Southport. The whole of the coast between the rivers Ribble and Alt is important both biologically and geologically and Ainsdale, designated in 1965, was the first reserve in the area. Now it is surrounded by a National Trust property and a Local Nature Reserve and most of the landowners work in tandem to conserve the habitats, although each has slightly differing objectives.

The conservation value of Ainsdale is mainly attributable to the presence of an open dune system, ranging from the beach, through mobile yellow dunes to the slacks and more stable grey dunes behind. However, this habitat gradient was disappearing. About 70 years ago a large plantation of mainly Corsican Pine was planted in two sections, a smaller shelter-belt behind the beach and the majority at the landward side of the reserve.

The plantation was causing problems mostly due to a local drop in the water table by up to 1 m and the sheltering effect against the salt laden on-shore winds of the seaward shelter-belt. Combined with the catastrophic decline of rabbits on the site due to myxomatosis, scrub was rapidly invading the dune areas, destroying the grassland and choking the slacks where Natterjack Toads breed.

The scrub consists primarily of Birch, with some Balsam Poplar. Sea Buckthorn, not native to the west coast, was introduced as a nurse crop to the Pines and as a deterrent against trespass. It has proved a very invasive and aggressive species here, forming impenetrable thickets. The final scrub type, Creeping Willow, is native to the area but, whereas in other places on the west coast it is restricted to the dune slacks, at Ainsdale it will grow over the whole dune system.

Management Objectives

Overall objective: Restoration of open dune vegetation to be achieved through removal of much existing woodland. Areas of Willow scrub to be maintained as a mosaic with open dune vegetation.

In 1988 discussions began with local authorities about the possibility of felling the seaward woodland, mainly composed of Corsican pine. The area was split into four 20 ha compartments to be felled four years apart beginning in 1990. A grazing regime would be introduced that would help the re-establishment of the dune grassland on these former woodland areas.

Maintenance of a large area of yellow dunes cleared of scrub by hand earlier is to be achieved by grazing, which will hopefully encourage a return of the herbs associated with dune grassland.

The landward woodland is to be left, both as a landscape and amenity feature but also because it is home to a healthy population of Red Squirrels. Firebreaks cut 15-20 years ago through the woodland will be left to scrub over, and possibly eventually turn into deciduous woodland. Large existing areas of Creeping Willow scrub are to be left and maintained as a mosaic with

open dune vegetation, though management methods had yet to be determined at the time of the site visit.

Management Techniques

A felling licence was granted to the reserve and in 1990 the first compartment was clear-felled. There was 4.5 ha of Pine, the rest of the 20 ha was scrub. Felling was undertaken by contractors, the timber sold and any left was removed or burnt. Stumps were left and treated with 'Timbrel'.

Many monitoring schemes were undertaken, including photography, profiles and cross profiles and quadrats.

Grazing was introduced immediately, some cattle at first helped break up the vegetation and break through in some areas to open sand, essential for the establishment of dune herbs. After this sheep were brought in, several breeds were tried but now a flock of Herdwick hill sheep are used. The cleared areas are to be grazed very heavily at first to prevent scrub regeneration but once the sward establishes itself the grazing pressure will be reduced.

The water table has returned to former levels, although it varies greatly across years, and the original vegetation in the dune slacks has returned after just two years. The area that had been under the Pines for 70 years is returning more slowly; it was found that the natural seed bank no longer existed here and so the vegetation is spreading from surrounding areas.

The monitoring process showed that the profile of the dunes did not change with the removal of the trees and so the second compartment was felled during winter 1996 / 1997. Felling is due to be completed in 2004.

Some strong local opposition to the scheme has been encountered, particularly among people who see the trees as a natural feature and also as a home to the Red Squirrel, even though the seaward wood is very poor habitat for them. While it is true that the felled areas look bad at first, especially with the stumps still in place, the future for the site lies in its open dune grassland and the associated flora and fauna, including Sand Lizards and Natterjack Toads.

ARNE RSPB RESERVE, Dorset (SY 9889)
(Visited 24/10/96)

Introduction

Arne is an RSPB reserve in South Dorset, situated on the edge of Poole Harbour. The reserve covers an area of 500 ha but only one part, Shipstal, is open to the public. Arne receives upwards of 30,000 visitors a year, the majority in the summer.

A wide range of habitats is represented, including lowland heath, reedbeds, saltmarsh and woodland. The reserve is particularly important for its birds, including Dartford Warbler, Nightjar and Hobby, and for its reptiles, all six British species being found here. Also present are sizeable areas of the rare Dorset Heath.

The scrub on the reserve is of four types: Birch, Pine, Gorse and Rhododendron.

Management Objectives

Overall objective: Maintenance of open heathland vegetation (ericaceous shrubs and Gorse) which involves removal of invasive trees (Pine, Birch, Rhododendron) and regular cutting and burning of Gorse.

The Birch thickets are generally to be left as they are although any encroaching onto the *Molinia* tussock fields in the south of the reserve are to be cut and sprayed.

Woodland areas of large Scots Pines are generally left, but some clearance is taking place on soils which will support Dorset Heath vegetation.

Pine and Birch scrub invading the heaths is to be cleared as and when required. Some individual trees will be left as song posts for birds and as aesthetic landscape features. Seedlings resulting from these, however, must be cleared.

Gorse is a vital habitat requirement for Dartford Warblers, their territories can almost be mapped by marking the Gorse clumps on the reserve, and so the current percentage cover is to be maintained, although it will be managed to prevent senescence and to create a range of age classes.

Rhododendron is a serious problem on the reserve, cloaking large areas completely. Attempts to remove it totally are being made and heathland is being encouraged to regenerate in cleared areas. The cleared ground from below Rhododendron thickets is virtually bare and sterile. Rotted down Rhododendron leaf litter appears to prevent other plants from germinating and consequently the heath is regenerating only very slowly where Rhododendron has been cleared. Once cut the Rhododendron is not being allowed to re-establish.

Wet heath in the south of the reserve will be managed from 1998 by a new regime of grazing at very low densities by cattle and / or ponies, to help prevent Birch invasion and to create ideal conditions for the wet heath flora. Grazing does not take place by domestic animals anywhere

else on the reserve but there is a sizeable population of Sika deer and some Roe. These are not currently considered a problem on the reserve.

Management Techniques

Since 1966 Pine scrub and seedlings have been cleared from the heath, usually by hand cutting or pulling if the plants are small enough. Areas of thicker Pine, once cleared, are reverting into good quality heath very quickly, even on ground recovered from mature Pines (50-70 years old). One of the main concerns when clearing Pine is the appearance of Bracken. Dense Bracken is sprayed using a tractor-mounted boom or by hand. Where Bracken is sparser, treatment is applied by a knapsack sprayer. Where large blocks of Pine have been cleared the build up of litter has been removed in places to aid the germination of the Heather and Gorse seedbank.

Any regenerating or invading Birch is cut and the stumps treated with Timbrel with a high success rate and very low levels of grow-back.

To maintain sufficient amounts of young and middle-aged Gorse on the heath, clumps are cut and burnt on a 15 year rotation. In the first few years of regrowth the Dartford Warbler does not immediately benefit but once the Gorse is sufficiently bushy, invertebrate numbers increase, so providing food and the bushes provide shelter.

Rhododendron is difficult to clear completely, especially where it occurs in large thickets. Contractors are employed with diggers to remove roots where possible and although this is expensive, large areas can be cleared effectively. Cut stumps are treated with 'Timbrel' and smaller bushes can be sprayed, the area is then left and the regrowth the following year is again sprayed. Any subsequent regrowth will be sprayed as and when it appears.

ASTON ROWANT, Oxfordshire (SU 7297)
(Visited 14/10/96)

Introduction

Aston Rowant National Nature Reserve, is situated between High Wycombe and Oxford with the M40, which was built in the early 1970s, passing through the middle in a deep chalk cutting. The reserve covers an area of 129.5 ha divided between Beacon Hill on the northern side of the motorway and Bald Hill to the south.

Woodland covers 30 ha, mainly open Beech woodland with areas of secondary Ash forming as scrub succeeds but the most important habitat is the chalk grassland which covers over 56 ha, including 46 ha of the nationally rare NVC classification of CG2. Sheep have grazed the site since at least 1792 but scrub invasion has become a major problem since the 1950s when myxomatosis decimated the rabbit population and sheep grazing pressure dropped; scrub now covers 21 ha.

The scrub on the reserve is diverse containing species such as Dogwood, Spindle, Whitebeam and Wayfaring Tree. There is also a large area of Juniper scrub on the western side of Beacon Hill which is growing in grassland.

Management Objectives

Overall objective: Maintain a diversity of habitats including chalk grassland, scrub and woodland. This is achieved mainly through grazing of existing chalk grassland and rotational cutting of scrub.

At Aston Rowant the scrub habitats have long been appreciated for their wildlife value, especially birds and invertebrates. The need for rotational cutting to maintain both age and structural diversity was recognised early on and several of the original objectives set for the reserve are still applicable, namely: to conserve a representative series of areas of scrub vegetation, leading from open chalk grassland to eventual woodland and to make adequate provision for the renewal of the scrub regeneration cycle. The main objective at this site now is to maintain all the habitats at their current levels with the exception of Beacon Hill where a reduction in the area of scrub is desirable to allow the chalk grassland to regenerate.

Scrub invasion into the grassland needs to be controlled across the whole reserve and grazing by sheep is the best method. The reserve has its own flock of c.100 Beulahs. Currently the sheep are removed from most grassland compartments in the summer to allow the flowers to bloom but this does not successfully prevent scrub invasion and many areas are further controlled through regular cutting. A change in the grazing regime is planned which will allow for more summer grazing of vulnerable areas.

Dogwood used to be a major problem, it was rapidly invading the chalk grassland and control was essential. After many attempts at differing methods of control, chemical means have been found to be very effective.

The Juniper bushes all appear to be of a similar age and are now approaching senescence. The recent high numbers of rabbits is suspected of being a major factor preventing the Juniper

regenerating. No new plants have been recorded since the 1960s and the planting of seedlings is being considered.

Some areas of diverse scrub are suffering through the invasion of woodland tree species, particularly Ash, Whitebeam and Yew. This is thought to result in a decline in the value of the habitat for nesting birds and so selective felling in these areas is undertaken on a need basis.

Management Techniques

Scrub patches used to be managed on strict rotation but the regime is more relaxed now. Various methods have been used, depending on the structure and growth form of the plants. Most areas of Hawthorn dominated scrub are cut on a six to seven year rotation, although a range of structures is encouraged, so some is left for longer. Most scrub cutting is done with volunteer help in the form of work parties or contract labour, with chain saws, brush cutters and slashers.

Areas that are to be cleared to allow the grassland to regenerate are clear felled. Stumps are then treated with 'Timbrel' to prevent regeneration. Most cut scrub is burnt and Hawthorn in particular must be removed as it can seriously injure sheep feet.

Large scale scrub clearance has been attempted in a 4 ha plot on the western side of Beacon Hill. Heavy machinery (a JCB HYMAC) was used to grub up and remove the vegetation in the hope of both allowing the Juniper to regenerate and also to recreate an area of calcareous grassland. Unfortunately the grass vegetation that has grown up is extremely rank and dominated by *Brachypodium*. High grazing pressures are needed to allow the less rank calcicole species to reappear.

Chemical control has been tried on Dogwood, which having broad flat leaves responds well to this method. An area of 0.75 ha that was sprayed four years ago, using knap-sack sprayers, with 'Timbrel' still has not regenerated. Also, very little damage was caused to the surrounding habitat as can happen with cutting, or even heavy grazing.

BARNHAM CROSS COMMON, Norfolk (TF 8783) **(Several visits during 1996 and 1997)**

Introduction

Barnham Cross Common is a Local Nature Reserve (LNR) located on the southern side of Thetford in Norfolk. It covers an area of 80 ha and is bisected by the A134. Flanked by houses in the north and an army camp to the south it is also adjacent to the BTO Nunnery Lakes Reserve and Thetford Heath. Historically the site was common land although it is now owned by Thetford Town Council with management supervised by English Nature. The major feature of this reserve is its Breck flora, comprising very short grassland on extremely poor sand which supports a large number of very scarce plants. The soil types on the reserve fall neatly into two categories. On the eastern side of the road the soil is fairly acid and to the west much more chalky, and it is here that most of the rarer plants occur.

Scrub is common on the reserve and is of three main types, self-seeded Pines from Thetford Forest and nearby shelterbelts, scrub Oaks and Gorse. This scrub has proved valuable as it holds a very healthy population of Nightingales in summer and a now traditional winter roost of Hawfinches (often in double figures). Butterflies are also well represented on the reserve with Dingy Skipper, Purple and Green Hairstreaks breeding.

Management Objectives

Overall objective: Maintain and extend the area of Breck grassland but retain some scrub to be managed by rotational cutting.

The running of the reserve is undertaken by a group of local volunteers under the guidance of English Nature. A 10 year management plan has been written and all conservation work follows this plan. As the primary attribute of the site is the ground flora the prevention of further scrub invasion is vital and removal of some of the scrub, particularly the Oak and Pine, is also advocated. Patches of Gorse are to be reduced and the remainder coppiced in order to encourage fresh growth. Ultimately only 10% of the reserve is to be covered with scrub. Due to the delicate balance of the soil nutrient levels any cut material must be removed, either physically or by burning, this includes both scrub and swiped grassland. Some replanting of Scots Pines is planned particularly along boundaries where many of the mature trees are now dying.

Relations with local people are important on this site. The reserve is heavily used, especially by dog walkers, and problems have been encountered with resistance to tree and scrub cutting. Breck grassland, unfortunately, does not have the aesthetic appeal of trees and changing peoples attitudes towards this site is important. Some vandalism occurs, mainly involving arson, and motorcyclists also attempt to use the reserve. One final problem emerging as the scrub is cleared is people driving onto the common to picnic.

Management Techniques

Virtually all of the management on the reserve is carried out by volunteer workparties between September and March. This usually involves cutting patches of scrub by hand with saws and billhooks. Several trained operators also cut the rank grass with brushcutters and larger trees are tackled with chainsaws. Previously all cut vegetation was burnt with the exception of grass which was raked up and taken off site, however the reserve now has the use of a 'chipper' which

will allow the waste to be removed and recycled. Herbicides are used to treat cut stumps of Oak as no root removal is carried out.

Grazing on the reserve is rather erratic, as although technically common-land no-one knows whether commoners rights exist for the site. Currently two people graze tethered ponies with the result that grazing effects occur in very discrete areas and currently the management group has no say as to where on the reserve the ponies are needed. Despite this, the grazing is generally beneficial. Breckland is known for its high rabbit population but since the outbreak of myxomatosis in the 1950s they have been surprisingly scarce on the reserve, only in the past couple of years has there been any number present. It is hoped that the numbers will continue to increase as these will help to maintain the very short sward needed by many Breckland plants. Mowing is used on this reserve more than on any other visited, primarily because grazing cannot be controlled. It is used for areas of young scrub invasion and near sites of fires where Rosebay Willowherb and Ragwort are appearing.

CASTOR HANGLANDS, Cambridgeshire (TF 1101) **(Visited 16/10/96)**

Introduction

Situated just to the northwest of Peterborough, Castor Hanglands NNR covers 100 ha and contains common grazing, graduating from dry chalk grassland to wetter neutral areas. Over half the reserve is deciduous woodland with thick scrub edges and there are also many isolated patches of scrub, both in the form of thickets and small Hawthorns distributed through the grassland.

Historically the area was heavily grazed by commoners which kept the scrub in a fairly stable situation. Controlled grazing has been re-established but grazing pressure from deer, especially Fallow, is high. Most of the isolated scrub is in well defined clumps with the current levels of grazing preventing any spread.

The most important scrub feature on the reserve is the large scrub bands bordering the woodland, the typical *mantel* form described by Tüxen (Hopkins 1996). The scrub is botanically diverse, including Spindle and Wayfaring Tree, but Blackthorn is an especially important species, both in extent and as the foodplant of the Black Hairstreak Butterfly which is found in good numbers at this site.

Management Objectives

General objective: Maintain a mosaic of species-rich grassland and scrub, including a diversity of age classes within the scrub.

The scrub on the reserve falls into two main categories, the woodland edge and the scrub patches, although the management is similar in both cases.

To maintain a range of structure and age classes, the scrub is rotationally cut and where areas are dominated by Hawthorn a more diverse regrowth is encouraged.

Black Hairstreaks prefer younger or middle-aged Blackthorn and so the scrub edges are coppiced on a rotational basis, with particular attention to those edges on the south side of the wood blocks, where the temperatures are slightly warmer and the butterflies more likely to be found. Because Black Hairstreaks require Blackthorn as their larval foodplant, the scrub is managed by removing Hawthorn in favour of the Blackthorn and also by removing invading tree species to prevent natural succession.

Hawthorn, however, has high value itself, for example as the breeding sites of *Agrilus sinuatus*, a Red Data beetle, which leaves characteristic 'D' shaped holes on the trunk as the beetle emerges. This species has only been found at Castor Hanglands and in the New Forest. The conditions it requires are not known and it is hoped that by leaving Hawthorns which already show signs of the beetle, the population will remain.

Since the 1930s there has been a very high population of deer on the reserve, primarily Fallow, but also some Muntjac. These help prevent any spread of scrub into the grassland but cause serious problems by destroying the understorey and browsing off regrowth when areas are coppiced, clear felled or layered. Control of the deer now seems useless so most effort is applied

to preventing the deer from grazing newly cut areas.

ITE have studied scrub regeneration on plots on the reserve and were cutting an area of 50 × 50m each year, over a period of 20 years and monitoring regrowth. One control plot that was fenced now contains dense, vigorous scrub but similar aged patches that were not protected have simply developed into rank grassland due to the deer grazing pressure. Now that this experiment has finished, cattle are being grazed on these rank plots to break up the structure a little before sheep grazing is introduced in an attempt to recreate good quality grassland, amongst which a few Gorse and Bramble patches will remain.

Management Techniques

Most of the scrub patches are cut on a 30 year rotation, which amounts to c. 0.25 ha a year being clear felled, about a month of work for the warden and a couple of helpers. If protected from deer this soon regenerates and quickly provides thick cover for birds and invertebrates. However, this works best on this site if the scrub has not been left for too long and allowed to get too leggy.

Older areas of Blackthorn are now managed by layering, using similar techniques to hedge laying, but carried out in blocks. The trunks are partially cut through and then laid down on the ground. The regrowth is rapid and very dense, and this also precludes the need to fence off from deer.

Grazing of the grassland by sheep is carried out under licence by a local grazier. Current levels of stocking are designed to maintain the species rich meadows and prevent scrub invading in these areas, with around 300 sheep present for up to four months.

FONTMELL DOWN, Dorset (ST 8817)
(Visited 22/10/96)

Introduction

Fontmell Down is a large dry periglacial valley, situated on chalk in North Dorset. The reserve is managed by the Dorset Wildlife Trust and comprises open chalk grassland with some areas of woodland, both native and planted, and large areas of mixed scrub. Gorse occurs primarily on the clay top of the hills.

The primary points of interest on this site are the flowers, especially orchids, and the butterflies. Compared to the other sites visited, Fontmell has a low level of management.

Management Objectives

General objective: Maintain existing chalk grassland and create a variety of age classes within the scrub.

Scrub encroachment is a fairly serious problem and several attempts to remove areas of mature scrub to allow the chalk grassland to regenerate have met with very little success so far. A large area completely cleared in 1991 still shows only bare chalk, ruderal weeds and rank grass around the edge. In the future, attention will be concentrated on preventing further scrub encroachment, in controlling the edges of the mature scrub, and creating a mosaic of age classes and structures within the mature scrub blocks.

Cats Whisker Plantation on the south side of the valley, is a mixed mature wood originally planted for timber. A forward plan intends to coppice this on a one acre site per year, removing all the conifers but leaving the area of mature Beeches as a hanger.

Grazing is done with a flock of 30-40 Wiltshire Horn sheep. One of the prime limiting factors on the site is the time needed for animal husbandry. Beulah sheep were originally used and although these are more willing to eat poor vegetation and scrub, problems arose with them due to a low level of supervision. A few Manx sheep have recently been purchased by the Dorset Trust and these will be tried on the reserve this winter to see if they more readily tackle scrub.

Management Techniques

The reserve grassland is split into 10 areas and one area is cleared of encroaching scrub each year, by brush cutters or by volunteer work parties. The brush is burnt. Most of this management takes place during the summer due to the availability of workers and the large amount that needs to be cut.

Mature scrub is scalloped around the edges on a fairly *ad hoc* basis but is only cut in the winter. The permanent scrub blocks are cut on rotation, with sparse or leggy areas being targeted first.

Some cattle are grazed in the autumn and winter by local graziers and these tackle the patches of taller, ranker vegetation which the sheep leave alone. The cattle can poach the ground badly

in wet weather, although a small amount of light poaching is welcomed, particularly for invertebrates.

An area of mixed Pine and Sycamore plantation that was almost clear-felled by volunteers in 1983 was subsequently replanted with native tree species, although a few Pine trees were left as standards. After 14 years there has been very little growth and the Sycamore is starting to regenerate from stumps. Subsequent management plans hope to include this block but as yet it is being left alone.

GIBRALTAR POINT, Lincolnshire (TF 5658)
(Visited 13/3/97)

Introduction

Gibraltar Point NNR, on the northern tip of The Wash, is comprised of 428 ha of dune and saltmarsh system, freshwater marsh, sandy and muddy shores. Sea Buckthorn is the predominant scrub type on the stable dunes, but is interspersed with Elder, Hawthorn and Privet. The mix of dune scrub and grassland and, in particular the dune slacks, are amongst the most important coastal habitats in Lincolnshire.

Visitor pressure on this site is high with 190,000 people or more recorded from the car parks each year. Many more, uncounted, walk along the beach from nearby Skegness. A visitor centre sees to their needs and much of the reserve has walkways and signposted trails in an attempt to limit damage to more sensitive areas.

Rabbit grazing was probably responsible for the suppression of the spread of scrub across the open dunes prior to myxomatosis; however through the 1950s and 1960s Sea Buckthorn invaded large areas of mature dune and associated dune slacks. The Brown Argus butterfly declined to extinction during the latter decade, probably as a result.

Scrub clearance was undertaken in earnest in the late 1960s, particularly on the oldest dune ridge where several acres were cleared by tractor-mounted machinery.

Management Objectives

Overall objective: Maintain all stages of vegetation succession including all stages of scrub development.

After scrub clearance operations, there follows a long period of dune turf re-establishment. A long established litter layer alters the nutrient status of the soil and the nitrogen fixing property of Sea Buckthorn also renders the soil enriched. Colonisation by ruderals such as Rosebay Willowherb, Creeping Thistle and nettles is more likely than by the typical dune flora and cutting and grazing regimes are necessary in the restoration process.

Rosebay Willowherb was recognised as a major problem in the mid 1980s when single species stands began to suppress floristic diversity.

The fundamental objective on the reserve is to maintain the full range of natural coastal habitats at every stage of succession. Hence the control of Sea Buckthorn is an ongoing task where it attempts to become established on dune grassland and clearance is still undertaken to restore areas of open dune slack.

Rabbit grazing plays an important part in the maintenance of a short dune sward which provides optimum conditions for a range of specialist dune invertebrates and ideal foraging habitat for Natterjack Toads. The resurgence in the rabbit population and the associated 'lawns' have allowed a successful, unassisted, re-colonisation by the Brown Argus, which began in 1994 and two years later a thriving colony existed.

Rabbit lawns are structurally uniform but exhibit valuable characteristics in terms of lichens, mosses and dwarf herbs. Presently there is a concern that the increasing rabbit numbers are

grazing areas of tall turf habitats to excess.

Management Techniques

Scrub management largely centres on the removal of encroaching Sea Buckthorn and the clearance of dune slacks. A 20 acre scrub block is managed by rotational cutting, one acre a year. Elsewhere large tracts of scrub are non-intervention areas which are left to grow to maturity. Occasionally, very high tides cause die back in the Sea Buckthorn when the roots are exposed to salt water for prolonged periods.

Attempts to control Rosebay have included hand-pulling, cutting and application of herbicide. More recently, grazing with Hebridean sheep has achieved a modest success. The sheep are fenced into plots of sprouting Rosebay until satisfactory grazing has been accomplished, occasionally some problem sites have received a second grazing the same season, but where potential erosion problems are recognised other forms of control must be adopted.

Hebridean sheep have also been instrumental in tackling Sea Buckthorn regrowth after dune slack clearance as well as grazing the dune meadows. However, the latter task has been negated in certain traditional grazing plots by the increasing pressure of rabbit grazing.

Scrub Management and Natterjack Toads

Natterjack Toads were recorded on the Gibraltar Point dune system until as recently as the 1940s. They require shallow, or even temporary pools for breeding, situated well away from patches of scrub which harbour their relatives, Common Toads. Common Toads out-compete Natterjacks for breeding sites and their tadpoles droppings contain a parasitic alga which inhibits the growth and reduces the survival of the Natterjack tadpoles (Griffiths *et al.* 1992). However, Common Toads do not survive in large numbers in the dry short sward and scrub free environment where Natterjacks thrive by digging burrows in the soil to escape predation and desiccation.

English Nature have recently supported a three year scheme to re-establish the Natterjack Toad to Gibraltar Point, during which time some 4,000 toadlets were released into specially dug shallow pools situated in the dune slacks. In 1995 the released Natterjacks spawned for the first time. Management of the area now concentrates on maintaining scrub-free, short turf areas of dune suitable for Natterjacks and at the exclusion of Common Toads.

MARTIN DOWN, Hampshire (SU 0419) **(Visited 20/3/97)**

Introduction

Martin Down NNR is a 394 ha site situated on the Hampshire-Dorset border. It has great historical significance, being bounded on one side by a Romano-British earthwork and intersected by a Bronze Age ditch.

The northern section of the reserve was last ploughed about 50-60 years ago and consists of very sparse grassland and bare ground with flint.

The section south of the main road comprises typical chalk and flint downland, with often steep slopes, last cultivated some 400 years ago. Large areas of grassland are interspersed with thickets of scrub of diverse species. Chalk heath also occurs, mostly towards the top of the escarpment or on loess deposits on flatter ground.

Some of the grassland contains very small, sparse Hawthorns amongst the very closely cropped herbs, other areas have more rank vegetation with larger, but still sparse scrub, mainly Blackthorn.

Management Objectives

Overall objective: Maintain the current balance between grassland and scrub, but creating a mosaic of age class structures within the scrub and enlarging the area of chalk heath.

The detailed objectives fall mainly into four categories: (1) to maintain the short grass sward, without allowing more scrub to invade; (2) to maintain an area of rank grass and herbs, interspersed with scrub for the Duke of Burgundy Fritillary; (3) to create a mosaic of age class structures within the scrub thickets and to cut the scrub on a rotation; (4) to encourage expansion of chalk heath by removing selected areas of scrub.

One of the most important features of Martin Down is its extremely poor soil. Annual vegetation production for grasses, herbs and woody species is low and therefore a light grazing regime and scrub clearance on a long rotation has dramatic results on the vegetation.

Management Techniques

Short grass sward

The chalk grassland is maintained by being grazed by sheep once or twice a year. Tiny scattered Hawthorns occur all through the sward but because each year any new growth is nibbled off none of the plants can 'grow away'. Some of these tiny Hawthorns are believed to be 20-30 years old. There is also very little invasion of new scrub plants because in their first one or two years, whilst seedlings, they will be eaten completely by the sheep and possibly voles, rabbits and deer. Therefore, provided grazing at low intensity occurs every year or two, there will be little change in the habitat.

Rank grass and scrub

Duke of Burgundy Fritillaries lay their eggs on Cowslips, but usually choose ones growing in rank grass in the shelter of a shrub. However they require open areas and the high temperatures found in full sun on open grassland as adults.

This rank grass and scrub habitat is the most difficult one to maintain on the reserve. Grazing at low enough levels to enable the grass sward to remain rank, currently on a three year rotation, does not prevent scrub growth and invasion. Much management is carried out by hand, involving cutting and scrub clearance as need arises. Individual bushes are cut and then the stumps treated, although with only one application there are invariably some side shoots that survive. A new grazing regime is going to be tried involving Hebridean sheep very lightly grazing regrowth every year. The Duke of Burgundy Fritillary site is also bounded by a high, thick hedge which is slowly being cleared to further open the area.

Scrub thickets

Several large mixed-species scrub thickets occur on the reserve. Current grazing regimes slow scrub expansion into adjacent grassland and the edges are swiped occasionally. Much of the scrub was even aged before management began and by using heavy machinery, a HYMAC and DROTT, sections of 0.1-0.5 ha have been cleared, mostly around the edges but also some glades have been cut into the heart of the thickets. Now, with regrowth there is a graduation from grassland to mature scrub and plenty of sites suitable for breeding birds, including Nightingale which has been lost on other nearby sites. As with much management on this reserve the work is carried out when it is needed and not according to a regular regime.

Chalk heath

Chalk heath is an uncommon vegetation type, characterised by Heather, a calcifuge growing on a chalk soil, often interspersed with calcicoles. This occurs due to the small scale distribution of more acidic silt or clay on the soil surface (Smith 1980). Chalk heath is found commonly around the higher parts of Martin Down reserve and its fine scale can be demonstrated by Dwarf Sedge, a rare plant characteristic of this reserve and a few nearby sites and a strict calcicole, growing in amongst the Heather bushes.

Where scrub has invaded areas that were historically chalk heath a programme of scrub removal has been brought in. Heavy machinery and chemical follow-up were used and dead material burnt *in situ*. The vegetation is then grazed at low level, along with the rest of the grassland and slowly the Heather plants are beginning to return.

OLD WINCHESTER HILL, Hampshire (SU 6420)
(Visited 21/10/96)

Introduction

Old Winchester Hill NNR is situated on the South Downs in Hampshire, 15 miles north-east of Southampton. It consists of 60.8 ha of often steep ground, 60% of which is chalk grassland. A quarter of the site is currently scrub and the rest is established woodland.

The scrub is species rich and includes a high proportion of Juniper which seems to readily regenerate here. The woodlands are dominated by Yew.

Management Objectives

Overall objective: Maintain the present proportions of grassland, scrub and woodland.

Scrub invasion into the grassland is a major problem, particularly involving Hawthorn and Dogwood and this must be controlled by cutting and grazing.

The reserve has two flocks of sheep totalling 50-60 animals. One flock consists of Beulahs, which are excellent at grazing down invading scrub and clearing areas once cut. Unfortunately they also require quite high levels of husbandry. The second flock is of Welsh X Wiltshire Horns or 'Easicare' sheep. These do not need shearing as they loose their wool all year round and require a much lower input of man-hours. Against them, however, is the fact that they are more selective eaters and are not as good at clearing scrub.

The prime limiting factor to the amount of sheep grazing available on the reserve is the lack of lay-back land in summer (grazing land which is not of importance to the reserve where sheep can be kept when grazing is sparse or if other management techniques are being used).

Currently there are no plans to clear any established scrub and try to restore the grassland but no new scrub is going to be allowed to develop. Preventing established scrub from becoming too old and leggy is also vital at this site, especially as the high level of rabbit activity causes scrub to rapidly become thin underneath. Attempts at gassing the rabbits have been made but with limited success.

The Yew woodland areas are to be scalloped around the edges and a small amount of scrub allowed to grow up to provide a thick ring around the edge to help prevent sheep breaking through the fences as Yew is highly toxic to them.

Management Techniques

The grassland areas are swiped on a 10 year rotation, so removing the invading Hawthorn. The grass is then grazed heavily by restricting sheep with Flexi-netting. Dogwood is more of a problem and excessive use of chemicals is avoided. It is cut manually in May and raked off. The regrowth is then re-cut in June. This kills around 90%. Any subsequent regrowth is either grazed (Beulahs will graze very young Dogwood but most sheep will not touch it) or sprayed with 'Amcide'.

Unfortunately the cutting of scrub requires fairly dry conditions and recent winters have been too wet, consequently not enough scrub has been cleared. The uncut vegetation is now too large to

swipe and cutting with saws and painting with 'Amcide' is advocated.

Established scrub is managed by removing the larger trees to prevent succession and by cutting on a 20 year rotation. On the southern side of the reserve Juniper is common and seedlings, which are quite numerous, are protected from grazing by individual cages.

SALTFLEETBY-THEDDLETHORPE DUNES, Lincolnshire (TF 4790) **(Visited 18/10/96)**

Introduction

Saltfleetby-Theddlethorpe Dunes consists of 952 ha covering an 8 km strip of the North Lincolnshire coast with dunes, scrub and freshwater marsh habitats, saltmarsh and foreshore. The NNR covers a smaller area than this but neighbouring Ministry of Defence land is managed with the NNR as a unit.

There are about 150,000 visitors a year, primarily to the beach and areas near to the car parks. This is approaching saturation point for the reserve.

60% of the dune area is currently covered with scrub which is dominated by Sea Buckthorn, but with Elder, Hawthorn, Privet and Blackthorn also present. Saltfleetby and the nearby reserve at Donna Nook contain approximately 50% of British Sea Buckthorn and are therefore very important for this species.

The Sea Buckthorn occurs in a narrow strip through the reserve. On one side it is kept in check by high tides and salt laden winds and on the other it is managed, both by manual cutting and by grazing. Surprisingly the plant is intolerant of salt water and will die off after the briefest inundation so the seaward edge of the scrub is a rather dynamic area with continual scrub invasion and dieback.

The older Sea Buckthorn community will eventually succeed to a more mixed scrub with Elder, Ash and Sycamore appearing. These species will be 'topped-out' by saltburn and so the community will not develop much beyond this stage. In strong easterly winds, which are common on the Lincolnshire coast, some of the older Buckthorn stems break and where this natural layering occurs fresh growth rapidly appears.

Management Objectives

Overall objective: Maintain open areas of dune grassland and a diversity of Sea Buckthorn age classes.

The primary objective with much of the Sea Buckthorn is to maintain a range of age classes and structure, and to encourage other scrub species in certain areas. In the main, the Sea Buckthorn scrub is self regulating but diversity of structure and age is maintained through cutting and coppicing.

A very large area of Sea Buckthorn near Rimac, towards the north of the reserve, was cleared over a period of a couple of years, to open up meadows which are rich in orchids and to protect the freshwater marsh sites from scrubbing up. These support scarce plants and Natterjack Toads. Isolated Hawthorns and scattered patches of mixed scrub were left and the site is to be managed with grazing and cutting if necessary.

Areas of dune grassland, primarily on the inland side of the reserve need to be kept mostly scrub free by grazing regimes. Sea Buckthorn suckers and it is this that becomes quite difficult to

control in the meadows around the margins adjacent to the scrub cover.

In recent years the reserve has suffered a 20% reduction in annual rainfall and since Sea Buckthorn is a shallow rooted species growing on sand some effect is expected. Monitoring will quickly show any changes in either distribution or regeneration abilities of the plants.

In the southern section of the reserve there is a major problem with a cultivated form of *Clematis*. It has been dumped at some time in the past and is invading the Sea Buckthorn scrub. It completely cloaks the scrub and eventually kills it, leaving impenetrable hummocks of *Clematis*. No effective method of control has as yet been found and at the moment it is being restricted to an area between two car parks by physically removing any plants spotted outside this area.

Management Techniques

Within the Sea Buckthorn scrub two areas of 0.5 acres each are cut in winter on a 'less than 20 year' rotation, this is done by hand, clearfelling and removing brash. Usually the cutting is done by the warden with one or two volunteer helpers. Since winter 1991 some areas of Sea Buckthorn have been coppiced, with the brash being burnt on site although this is done on a more *ad hoc* basis.

Many grazing regimes have been tried on the dune grassland, both with cattle and the County Trust's flock of Hebridean sheep. Much depends on the conditions each year as grazing this dune reserve in dry seasons causes unacceptable levels of erosion. Consequently the grassland areas have been able to take very little grazing during the past three hot summers.

Rabbit grazing is also a factor on the reserve, especially within the Sea Buckthorn scrub which the sheep do not graze. The rabbits are opening up the ground beneath the scrub and also on the dune grassland near the scrub, so producing ideal conditions for the Buckthorn to sucker into the grassland. This invasion is controlled twice a year by cutting with a brushcutter.

THE LIZARD, Cornwall (SW 7323) **(No site visit but management discussed with site manager)**

Introduction

The Lizard NNR covers an area of 1,547 ha over the Lizard Peninsula in Cornwall, in several isolated patches. In 1677 John Ray discovered Cornish Heath growing here and ever since the area has been recognised for its outstanding plant communities.

The Lizard has a large outcrop of serpentine rock, from which derives a unique soil type and, consequently, vegetation. Only the heaths in south-west France are similar. Two vegetation types, NVC H5 and H6 are unique to The Lizard and a total of 18 nationally rare species of plant occur within the NNR. The reserve is also important for birds with a total of 86 breeding species including species associated with heathland and rocky coastal habitats.

Much of The Lizard NNR is covered with lowland heath or maritime grassland. The scrub is dominated by Western Gorse. Because of the climatic conditions the plant community would not succeed to any other but the Gorse would spread and eventually degenerate. There has been a very long history of grazing on the heaths and coastlands of The Lizard but over recent decades the grazing pressure has declined significantly, leading to an invasion of scrub and a reduction in the age class mosaics within both the heath and scrub.

Management Objectives

Overall objective: Maintain and enhance the open heathland, particularly to prevent further expansion of Gorse.

Since the purchase of the first 42 ha in 1974 the main priority has been to protect the site from fire. Once firebreaks and water holes have been created, the emphasis shifts to reintroducing grazing and to prevent the further spread of Gorse into the heaths.

The objectives fall broadly into five categories:

- To maintain the unique and diverse heathland types.
- To maintain the unique and diverse coastal grasslands.
- To restore degraded habitats.
- To maintain minor habitats (pools, scrub, conifers).
- To increase populations of rare plants and animals.

Management Techniques

Most of the grazing on The Lizard is undertaken with cattle and ponies. Although English Nature own a small number of Shetland and Exmoor ponies and a flock of Soay sheep, the main portion

of the grazing is carried out by graziers under licence. Each section of the NNR is grazed at different levels and this is reviewed each year, so no standard regime has been set up.

Areas of scrub, particularly thick old Gorse, are controlled by cutting and burning where appropriate, usually in areas of six to seven hectares. However, priority lies with areas where there is a direct threat to specific rare plant locations and so less sensitive areas are left, thus increasing the diversity of age classes present throughout the reserve.

Some heath burning occurs now, on a 10-15 year rotation, helping to reduce amounts of Gorse and to break up even-aged stands of heath. Once regrowth begins grazing is reinstated. Since The Lizard became an NNR there have been no major uncontrolled fires, the last one being in 1976. The vegetation rapidly recovered from the fire but there is now a substantial area of even-aged heath.

Although the main emphasis of scrub management is on preventing further scrub encroachment, some areas on the coastal parts of the NNR are managed by rotational cutting to maintain the habitat structures most attractive to nesting and feeding birds.

Increasing the habitat mosaic further by using more intensive grazing and controlled burning to open up large areas of short turf is an important aspect of habitat management with respect to any future attempt to reintroduce the Chough, which last bred in 1865.

NEW FOREST, Hampshire (Visited 23/10/96)

Introduction

The New Forest is a huge area of heath, grassland, bog, ancient woodland and commercial forestry. The mosaic of semi-natural habitats that makes up the New Forest is of exceptionally high nature conservation importance. The SSSI covers c. 29,000 ha and stretches from The Solent to Ringwood in the west and Fordingbridge in the north. The New Forest has a unique history as a hunting preserve for kings and as common grazing. The grazing has continued through to the present time and even now fencing cannot be erected anywhere except around the timber growing areas. The grazing pressure within the forest is huge and currently there are 2,500 ponies, mostly the native New Forest type, 3,000 cattle and 3,000 deer, 2,000 of which are Fallow. There are populations of both Red and Sika deer.

One of the unique features of the New Forest is the 'lawns', areas of very short, herb rich sward which develop near the many streams which run through the forest - containing such species as Chamomile which the grazing animals favour. These are very important to the character of the forest and many of the rarer plant species occur in this habitat. Further from the streams, the drier more acid soils develop a grass-heath vegetation and this grades into heathland.

Mill Lawn (SU 2303), near Lyndhurst was visited as a representative area as it shows the characteristic scrub types of the New Forest within a relatively small area. Scrub occurs in several situations within the New Forest: (1) as a colonist of the lawns; (2) Pine and Birch are colonists of heathland; (3) Gorse scrub is an integral component of heathland and acid grassland. In addition, Rhododendron and its less common relative *Gaultheria shallon* are recognised as becoming serious problems. So far no attempt has been made to control the growth but English Nature are currently looking into the situation and some form of control will probably be implemented soon.

There are three main differences between the New Forest and the other sites examined. First, the sheer scale of the site. Second, the land is under such high grazing pressure that regeneration of bushes and trees is localised in time and space. Third, the New Forest is not a nature reserve but rather an extensive tract of land that continues to be managed according to its traditional land-uses.

Management of Lawns

Because of the high grazing pressure, scrub appears not to have been a 'problem' in recent history until the First and Second World Wars when the number of animals present in the forest dropped dramatically. A large amount of Birch and Pine scrub appeared on the edges of the lawns, encroaching from the areas of woodland. As the scrub was well established by the time the numbers of animals started to build up again, subsequent grazing had little effect.

This scrub is still present and even-aged. It is now about 50-60 years old and appears to be poor habitat for vertebrates, it also shades out herbs and takes up a large area of the lawns. As well as being of botanical value, the lawns are preferred by the graziers for their animals and a decision was taken to remove large areas of scrub on several badly affected lawns throughout the forest. Over the past three years the Birch and Pine has been felled by forestry workers using large felling machinery, which has enabled the work to be done relatively quickly and cheaply because

it was done 'in house'.

In these areas, the lawn vegetation is returning very rapidly, the high grazing pressure is preventing rank herb species invading and also stopping any regrowth of the scrub. Some small areas of scrub, particularly those rich in nectar-bearing species, such as Hawthorn, Blackthorn and Buckthorn, have been left to provide habitats for insects and shelter for the grazing animals.

Management of Heaths

Pine regeneration has become a problem on some areas of heath. At Mill Lawn much of this has now been removed and, again, the high grazing pressure prevents any new regeneration. Bracken often colonises these areas and it already covers large areas of the New Forest. Forage harvesting is carried out by contractors on some stands of Bracken that are level enough for cutting. This technique is working well and as the leaf litter is also removed it is not only controlling the Bracken but also allowing the herb-rich sward to rapidly recolonise.

Management of Gorse

The final scrub management currently carried out in the New Forest is burning of Gorse. This has historically been carried out regularly by graziers to promote young shoots for grazing animals in the winter and to control the spread of Gorse onto grassland. Since 1949, however, a controlled programme of heath and Gorse burning has been conducted by the Forestry Commission (Tubbs 1986). According to Tubbs, the burning of Gorse coupled with the high grazing pressure, has widely suppressed its regeneration and many Gorse brakes have disappeared or died back. He argues that the management of the Gorse deserves special attention because not only does it provide food and shelter for stock but it is a valuable wildlife habitat. Among birds, heathland Gorse is especially important to Dartford Warblers.

APPENDIX 2

EXAMPLES OF NATIONAL TRUST PROPERTIES WHERE MANAGEMENT IS BEING UNDERTAKEN SPECIFICALLY FOR SCRUB

Habitat	Property	Reasons for Scrub Management
Wetlands	Wicken Fen	To retain scrub and Carr communities
	Newton Links, Northumberland - Willow coppicing	Screen for birds, and to retain communities
Lowland heath	Danbury Common, Essex - Hawthorn and other types of scrub	For Nightingale (very successful)
	Milford Common, Surrey - Hawthorn scrub	Coppiced and rejuvenated by layering, for Nightingale
	Bookham Common, Surrey - Hawthorn and mixed scrub	For Nightingale
	Holmwood Common, Surrey (now wooded common)	Rotational cutting of Blackthorn for Brown Hairstreak
	Headley Heath, Surrey	Gorse management for Dartford Warbler and other birds (Linnet, Tree Pipit, etc)
	Headon Warren, Isle of Wight - mixed scrub including Gorse and other types of undercliff	Valued for birds and invertebrates; no management necessary as cliff instability ensures continued rejuvenation and mosaic
Calcareous grassland and scrub	Coombe Hill, Bucks - mixed calcareous scrub	To retain varied scrub communities, including relict Juniper
	Stockbridge Down, Hants - mixed calcareous scrub	As above
	Ventnor Downs, Isle of Wight - Holm Oak scrub	Edges provide valuable 'saum' for flora (DB); being managed to achieve c 40% cover, by goats (which provide good graded edge) chainsaws and chemicals
	Cissbury Ring - Hawthorn scrub	For scrub birds
	Newtimber Hill - plateau Gorse on clay-with-flints	To perpetuate the community
Calcareous grassland and scrub	Coombe Hill, Bucks - plateau	To perpetuate the community

Habitat	Property	Reasons for Scrub Management
(continued)	clay-with-flints	
	Steps Hill, Herts - plateau clay-with-flints	Long term bird ringing site. Predominantly Hawthorn scrub managed for birds
	Lardon Chase, Berks - Hawthorn	To create and maintain edges for invertebrates and vascular plants
	Heathwaite and Arnside Knott, Cumbria - Birch and mixed scrub	Edges managed as 'linear coppice' for High Brown Fritillary
	Tennyson Down, Brook and Compton Downs and Mottistone Down, Isle of Wight - plateau Gorse on clay-with-flints	Management by rotational cutting and some burning to perpetuate the habitat and for Dark-green Fritillary
	Headley Heath, Surrey - calcareous scrub	Management for Dormouse
	Selborne Common, Hants - calcareous scrub	Rotationally cut for Nightingale and Brown Hairstreak
	Harting Down, West Sussex - Hawthorn	Rotationally cut for Brown Hairstreak
	Crook Peak - Shute Shelve, Mendip Escarpment - Gorse and Hawthorn scrub	Rotationally burnt to retain, e.g. for Dartford Warbler
	Ashcombe Bottom, Black Cap, Lewes - mixed calcareous scrub and Gorse / Bracken	Management to diversify age structure, create edges and enhance a massive scrub area for birds and inverts. Long history of bird recording by Roy Leverton
	Purbeck Downs - Gorse scrub	Massive invasion of Gorse a big problem; management mostly aimed at reduction but some deliberate coppicing e.g. at Ballard Down
	Upper Wharfedale - limestone grassland / scrub saum habitats	Endeavouring to restore and create more of this habitat, although summer grazing levels are at present too heavy (Wildlife Enhancement Schemes have potential)
Coastal scrub	Nare Head, The Dodman, Pentire Head and many sites on the Cornwall and Devon coasts - Gorse scrub	Managed by rotational cutting and burning to maintain vigorous but gladed Gorse as a valuable habitat in its own right and for associated invertebrates and birds

Habitat	Property	Reasons for Scrub Management
	Newtown, Isle of Wight - scrub along fringe of upper saltmarsh at edge of ancient woodland	Valued as part of successional series from open mud; no management necessary?
	Darra Island, Strangford Lough, Northern Ireland	Scrub-grassland mosaic is of value and is maintained by goats
	White Park Bay, Co Antrim, Northern Ireland - scrub-grassland mosaic	Important for invertebrates and birds; maintained by cattle and sheep
Uplands	Thwaites Fell and Wallowbarrow, Duddon Valley - Juniper	We would like to manage it if we knew how!
	Glencoyne Park, Ullswater - Hawthorn	As above!
	Marsden Moor, Yorks	Planting and fencing gills and cloughs to provide new scrubby woodland, for Ring Ouzel and other wildlife
	Darnbrook Farm, Malham, Tarn	As above
	Bridestones, North Yorks - Birch scrub and upland heath	Birch requires management to retain habitat, but not allow undue spread into open heath
Wood Pasture	Hatfield Forest - mixed scrub, Hawthorn and Bramble	Provides nursery cover for young trees on the grazed plains, as well as invert. food source. Maintained by cattle grazing

APPENDIX 3

NAMES OF PLANTS AND ANIMALS MENTIONED IN THE TEXT

PLANTS

Bracken	<i>Pteridium aquilinum</i>
Corsican Pine	<i>Pinus nigra var maritima</i>
Scots Pine	<i>Pinus sylvestris</i>
Juniper	<i>Juniperus communis</i>
Yew	<i>Taxus baccata</i>
Holm Oak	<i>Quercus ilex</i>
Oak	<i>Quercus spp (petraea, robur)</i>
Willow	<i>Salix spp</i>
Creeping Willow	<i>Salix repens</i>
Balsam Poplar	<i>Populus candicans</i>
Birch	<i>Betula spp (pendula, pubescens)</i>
Beech	<i>Fagus sylvatica</i>
Nettle	<i>Urtica spp (dioica, urens)</i>
Clematis spp	<i>Clematis spp</i>
Whitebeam	<i>Sorbus aria</i>
Hawthorn	<i>Crataegus monogyna</i>
Bramble	<i>Rubus fruticosus agg</i>
Blackthorn	<i>Prunus spinosa</i>
Gorse	<i>Ulex spp (europaeus, gallii, minor)</i>
Western Gorse	<i>Ulex gallii</i>
Sycamore	<i>Acer pseudoplatanus</i>
Spindle	<i>Euonymus europaeus</i>
Box	<i>Buxus sempervirens</i>
Buckthorn	<i>Rhamnus catharticus</i>
Alder Buckthorn	<i>Frangula alnus</i>
Sea Buckthorn	<i>Hippophäe rhamnoides</i>
Rosebay Willowherb	<i>Chamerion angustifolium</i>
Dogwood	<i>Cornus sanguinea</i>
Cornish Heath	<i>Erica vagans</i>
Dorset Heath	<i>Erica ciliaris</i>
Bell Heather	<i>Erica cinerea</i>
Common Heather	<i>Calluna vulgaris</i>
Rhododendron	<i>Rhododendron ponticum</i>
'Gaultheria'	<i>Gaultheria shallon</i>
Cowslip	<i>Primula veris</i>
Ash	<i>Fraxinus excelsior</i>
Privet	<i>Ligustrum vulgare</i>
Wayfaring Tree	<i>Viburnum lantana</i>
Elder	<i>Sambucus nigra</i>
Ragwort	<i>Senecio jacobea</i>
Chamomile	<i>Chamaemelum nobile</i>

Creeping Thistle		<i>Cirsium arvense</i>
Orchid	<i>Orchidaceae</i>	
Grass		<i>Molinia</i> spp
Brome		<i>Brachypodium</i> spp
Dwarf Sedge		<i>Carex humilis</i>

INSECTS

High Brown Fritillary	<i>Fabriciana adippe</i>	
Dark-green Fritillary		<i>Mesoacidalia aglaja</i>
Duke of Burgundy Fritillary		<i>Hamearis lucina</i>
Black Hairstreak		<i>Strymonidia pruni</i>
Purple Hairstreak		<i>Quercusia quercus</i>
Brown Hairstreak		<i>Thecla betulae</i>
Green Hairstreak		<i>Callophrys rubi</i>
Brown Argus		<i>Aricia agestis</i>
Dingy Skipper	<i>Erynnis tages</i>	
Jewel Beetle (Red Data Beetle)		<i>Agrilus sinuatus</i>

VERTEBRATES

Hobby		<i>Falco subbuteo</i>
Turtle Dove		<i>Streptopelia turtur</i>
Long-eared Owl		<i>Asio otus</i>
Nightjar		<i>Caprimulgus europaeus</i>
Starling		<i>Sturnus vulgaris</i>
Tree Pipit		<i>Anthus trivialis</i>
Whitethroat		<i>Sylvia communis</i>
Garden Warbler		<i>Sylvia borin</i>
Dartford Warbler		<i>Sylvia undata</i>
Nightingale		<i>Luscinia megarhynchos</i>
Ring Ouzel		<i>Turdus torquatus</i>
Chough		<i>Pyrrhocorax pyrrhocorax</i>
Linnet		<i>Carduelis cannabina</i>
Hawfinch		<i>Coccothraustes coccothraustes</i>
Natterjack Toad		<i>Bufo calamita</i>
Common Toad		<i>Bufo bufo</i>
Sand Lizard		<i>Lacerta agilis</i>
Rabbit		<i>Oryctolagus cuniculus</i>
Muntjac		<i>Muntiacus reevesi</i>
Roe Deer		<i>Capreolus capreolus</i>
Fallow Deer		<i>Dama dama</i>
Sika Deer		<i>Cervus nippon</i>
Red Deer		<i>Cervus elaphus</i>
Red Squirrel		<i>Sciurus vulgaris</i>

Dormouse

Muscardinus avellanarius

